Dialogic multiculturality in mathematics class

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Introduction

This paper analyzes the possibilities of analysis of multicultural phenomena in the classroom. In the recent years Spain has become a country that receives immigration. More and more our classrooms are coexistence and learning spaces in which come together students from different backgrounds, both social and cultural. Over the past seven years there has been a change on the total population[4] from 1,6% to 6,2%. This indicator reflects that the Spanish society is more and more multicultural. It is possible to state that from 1996 to 2001 the percentage of "foreign students" in Spanish classrooms went from representing the 0,84% to 2,17% of the Spanish school age population. In a period of less than 5 years, the number of foreign students has almost doubled.[5] In this context it is very important to do research that allow us to improve the quality of the education that takes place in our classrooms. Within this framework the aim of our paper is to show throughout the dialogic learning (Flecha, 2000) that it is possible to improve mathematic rationality with informal ways of doing mathematics.

This paper refers to several research projects and experiences carried out lately from CREA at the University of Barcelona. For that reason, the methodology used is the analysis of documents. We also use the technique of contrast of specific examples, as an argumentative resource. By means of several specific examples we offer orientations targeted to teachers of mathematics in order to improve their teaching in the classrooms which are characterized by great sociocultural diversity.

Background

For several decades, research have been undertaken from the sociocultural perspective (approach) in the didactics of mathematics. Nowadays there are several ongoing research projects from the multicultural perspective (approach) in the regular compulsory education. Some of those analyze the meanings of the subjects that participate in the mathematic activity acknowledging key concepts like transition, norms, negotiation, communication and "foreground" (Gorgorió y Planas, 2003). Among others there are specific programs connected with the training of teachers (Favilli, Oliveras César, 2003). In other cases there are specific analysis of individual productions of the immigrants that manifest specific difficulties (Moreira, 1998), analysis of specific cultures (Marchini, 2002; Novotna y otros, 1998), the role of language in the construction of the mathematical knowledge (Díez, Giménez, García, 2005; Cobb, Hodge, 2002; Gorgorió, Planas, 2004) or even historical interpretations of the mentioned processes (Spagnolo, 1998). For these reasons we show the interests of the research community on mathematics education with regards to social cohesion problems, personal and collective identity and its implications with the educational system.

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[4] Data from INE. *Boletín informativo del Instituto Nacional de Estadística*. March 2004. http://www.ine.es.
[5] It has gone from 62.707 foreigner students registered in the school year 1996/97, to 120.222 for the school year 2000/02 (which means an increase of 57.515 in absolute numbers). Data from the report of the Defensor del Pueblo. 2003.

Through the study of these topics, recent research based in sociocultural theories focus on the need to find an answer with regard of how to prepare teachers of mathematics and how to teach maths in school by using the diversity in our classrooms as a resource to produce higher quality education. The theory of ***dialogic learning*** (Flecha, 2000) is a theoretical and methodological multidisciplinary approach that starts from the direct observation of reality.[6]

Related experiences

There are several research projects and experiences that illustrate the success of the dialogic learning in multicultural classrooms. We here highlight two examples from adult learners groups.

First example

The first example refers to a group made in the school year 2001/2002 by six people that designed a web site with exercises of mathematics pertaining to the level of high school. The individuals in this group mainly came from different social backgrounds. The group was mainly composed by women. Their social backgrounds were different: while some had never attended school others did. Some were housewives while the others worked as a housecleaner or even have their own businesses.

The activities developed by the group worked under the dialogic learning principles. Women from the first group solved exercises from the mathematics book. The proposed activities revolved around a situation that occurred in the local market. Later on, the same women answered to other series of questions posted in a web page (that was made by themselves).

The work developed on the concept of proportions made possible a research study (Díez, 2004) in which the importance of the social and cultural variables where highlighted by all the women. Those variables (which were stated as prior experience and heritage of prior knowledge –Schütz, 1977–) were a key conditional to the academic results regarding the learning of the formal concept of "proportion" as a well as the way to convey the learning itself.

> Person 3. … k is three euros, k is k, from kilo... <moves head doubtfully>
> Teacher. k is the constant, it means constant.
> Person 4. That is, given to k different values for the first magnitude, mass, we obtain values for the second magnitude.
> Teacher. That is what you have calculated, isn't it?

In this quotation, person 3 associates letter k with the meaning of Kilogram. This association of ideas is the result of the Spanish cultural context, because in Spain we use the kilograms as a measure (not the case of countries with Anglo-Saxon tradition where other kind of units are used as pounds or ounces). That's why it is "normal" to associate that letter with the idea of kilogram. But in the exercise was posed as the constant of proportionality symbol.

Later on, during the same session, person 5 reads the wording of another exercise, in which the meaning of the constant is asked.

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[6] It is based in seven principles: 1) egalitarian dialogue, 2) cultural intelligence; 3) transformation; 4) instrumental dimension; 5) the meaning creation; 6) solidarity; and 7) equality of differences.

Person 5. What is the numeric value and the meaning of the constant, kilograms, in this case?
Teacher. No, kilos, no… the constant…
Person 5. the constant of k…
Teacher. What the constant means, what is the constant?
Person 5. Ten.
Teacher. Ten, what?
Person 2. Ten hours.
Person 5. Ten kilos, isn't it? In an hour 10 kilos are sold …

Through the egalitarian dialog (where each one contributes with what s/he knows in order to solve the exercises together), people that takes part in the group can understand the meaning of the idea of constant of proportionality, and that can be associated to different things (kilos, euros, etc.).

Second example

The second example brings us to a math class in the adult school of La Verneda – Sant Martí with two Spanish women, a man from Senegal, two men from Morocco and a woman from the Dominican Republic.[7] In several interviews (also regarding the concept of proportionality) appeared contributions like the importance of egalitarian dialog and cultural intelligence.

Firstly, the interviewer asks to each person what they understand about proportionality. All of them use examples from their context of daily life in order to define this concept. Nevertheless, they do it with hesitation, without being certain of giving a correct answer.

Interviewer. How do you define a proportion? I'm a student and you have to explain me what a proportion is. How would you do it?
Person from Morocco (1). I can't explain you.
Interviewer. You can explain me in French. I understand both French and Spanish.
Person from Morocco (1). I don't know… ¿what is it?
Interviewer. Ok, If I put you these numbers, can you see any relation within them?
Person from Morocco (1). Yes, yes … among them… they are… they are proportional

One of the Morocco people (person 1) uses an example of his day-to-day experience to explain what is understood by proportionality.

Person from Morocco (1). So, easy examples as the one of the open market, that you go to buy or people that takes coffee … they are 3, and ask something, and they have, for example, 10 euros and they have to pay them. How they have to divided…? Proportionally.

In the case of the person from Senegal appears a cultural reference in his argumentation. This student uses the preparation of a specific dish (the *iasa*, which is meat and boiled onion), to explain what proportionality is, in a practical way (through wrong mathematical arguments).

Person from Senegal. I think when you talk about the proportion it is to do the equivalent, or calculating prices that can be done when you go to the market… maybe… I, for example, prepared a "*yasa*"... a *iasa* is onion with meat. So then it is for going there and you check the prices of the meat… But this is also applicable to the offer and demand… because for example, in the market there are a lot of people who ask for the same thing, then the prices are lower… but for example not a lot of people want to do *iasa*, then the prices go up.

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[7] Due to the space limits, we are only referring to the arguments of two of these five people.

The same person (from Senegal), when is in front of a numeric series, he identifies at once that there is a proportional relation among some of the numbers that form part of it. That shows that he knows perfectly what proportionality is and what it is not? (although the difficulties that he has in order to define practically what proportionality means).

As in the prior case (first example), people who take part of this second case also use as reference some elements of their daily life to give sense to the idea of mathematic proportionality.

Conclusions

In the examples seen, culture (or cultural elements) appears as mediator to explain the mathematic concept of proportion. Culture is mediator because it becomes in the referent of the contributions used by the interviewed people. Each person tries to understand the meaning of proportionality in the context of their own daily life. So, "cultural elements" are used to make sense to the idea of proportion.

Those two examples show that an education based in dialogic learning is a good answer for teachers of mathematics that are willing to look for ways to improve mathematic rationality based on argumentation and formal reasoning starting by legitimating informal mathematics explanations. It seems specially important for adult education. By starting from an egalitarian dialog situation in which the voices of everybody are included (taking into account the specificity of the social and cultural heritage of each of them), and starting from the cultural intelligence, there is a way to transform the education offered in our classrooms by enriching those spaces with their contributions and creating a greater learning (and more quality) for all the students.

To take into account and to take advantage of the multiculturality factor turns out to be fundamental in the present Spanish classrooms, because recontextualizing in the mathematic speech the previous knowledge (mediated by the culture and the social origin) of each person, the result is to provide back the meaning to the school and to obtain better academic results like the success shown by the learning communities.

References

Cobb, Hodge. 2002. "A relational perspective on issues of cultural diversity and equity as they play out in the mathematics classroom" Mathematical Thinking and Learning. 4(2&3). 249-284.

D'Ambrosio. 1999. "Educació matemàtica per a una civilització en prcès de canvi" en *Temps d'Educació*, 22(1999): 29-49.

Defensor del pueblo. 2003. *La escolarización del alumnado de origen inmigrante en España. Análisis descriptivo y estudio empírico.* Madrid.

Díez, Giménez, García. 2005. *Analysis of proportional reasoning in a multicultural classroom of adults*. CERME 4. Sant Feliu de Guixols. Spain.

Favilli, F., Oliveras, M.L. & César, M. 2003. Bridging Mathematical Knowkedge from Different cultures: Proposals for an Intercultural and Interdisciplinary Curriculum. In N. A. Pateman, B. J.

Flecha. 2000. *Sharing words.* Rowman & Littlefield Publishers, Inc. Lanhan, Boulder, New York, Oxford.

Gerdes. 1989. Find the missing figures A series of geometric problems inspired by traditional Tchokweband drawings (Angoola) and Tamil threshold designs (India). *Mathematics Teaching*. Derby. Vol. 124. (0, 18-19, 50).

Gorgorió y Planas. 2003. "Transitions: for background to foreground" en M.A. Mariotti *Proceedings of the CERME 3 Conference*, CD Rom, Pisa. Italy.

Gorgorió, N.; Planas, N. 2005. Social representations as mediators of mathematical learning in multiethnic classrooms. *European Journal of Psychology of Education, 20*(1), 91-104.

INE. *Boletín informativo del Instituto Nacional de Estadística*. Marzo de 2004. http://www.ine.es.

Knijnik, G. 1996. *Exclusao e resistência. Educaçao matemática e legitimidade cultural.* Porto Alegre: Artes médicas.

Marchini, C. 2002. "La formazione degli insignanti, problemi culturali e didattici" en Atti del Congresso Mathesis,

Matova, M. Luchhini, G. Mercanti, F. Tallini, LG. 2001. *Per una nuova scuola: programmi, formazione e tecnologie innovative per l'insegnamento della matematica.* 43-57.

Moreira. 1998. "Facing exclusion: the student as person".
http://www.nottingham.ac.uk/csme/meas/papers/moreira.html.

Novotna, Y. y otros 1998. CLIL and Mathematics Education. http://math.unipa.it/grim/Jnovotna.pdf.

Orellana, et alii. 2003. Desarrollo cognitivo y aprendizaje de la lectura. *Pensamiento Educativo.* Vol. 32 90-106.

Spagnolo, F.. 1998. *Insegnare la matematiche nella scuola secondaria.* La Nuova Italia. Firenze.